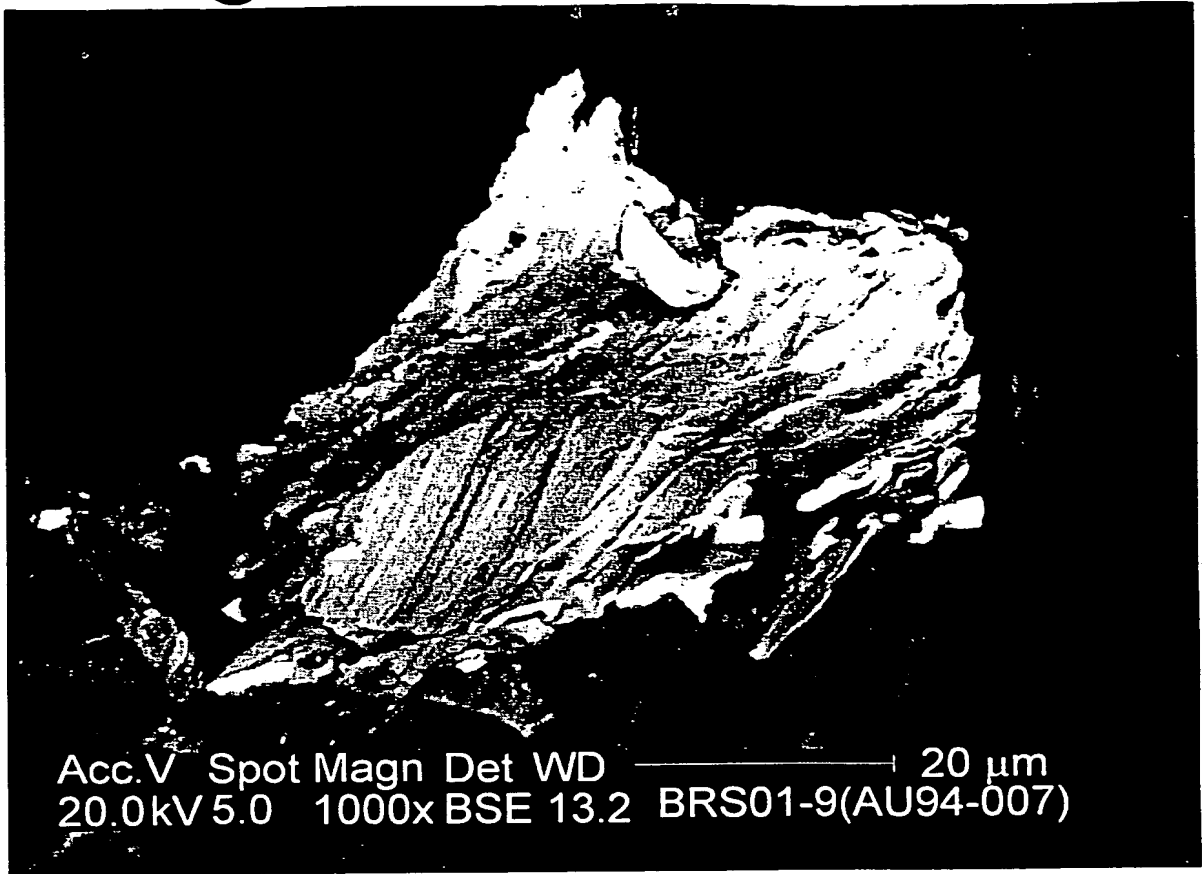
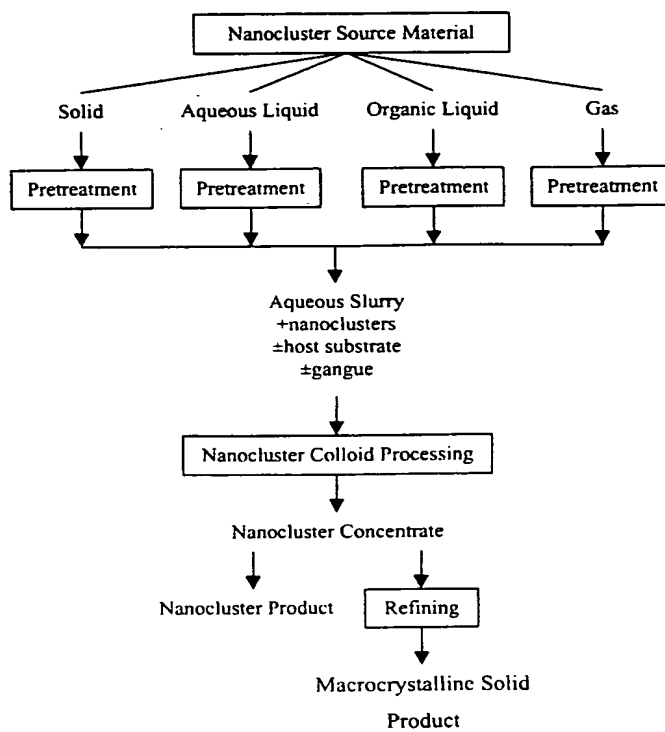


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**FIGURE 3.** A schematic flowsheet of the various aspects of the invention.



**Figure 4.** A flow process diagram of pretreatment processes, in accordance with the invention. Explanation: horizontal arrows indicate process; OP indicates optional process; underlined indicates material or process product; a downward pointing vertical arrow indicates process products that are advanced to subsequent processing step.

4A. SOLID NANOCLUSTER SOURCE MATERIAL

- OP: PREVENT FROM DRYING
- CRUSH
- MILLING
- ↓ NANOCLUSTERS + HOST SUBSTRATE + GANGUE ± WATER
- SLURRY
- ⇒ TO NANOCLUSTER COLLOID PROCESSING

4B. AQUEOUS LIQUID NANOCLUSTER SOURCE MATERIAL

- OP: PREVENT FROM DRYING
- ⇒ OP: TO NANOCLUSTER COLLOID PROCESSING
- PHASE SEPARATION
  - WATER: to water treatment or recycle
- ↓ NANOCLUSTERS ± HOST-SUBSTRATE ± GANGUE
- SLURRY
- ⇒ TO NANOCLUSTER COLLOID PROCESSING

Figure 4. Continued.

4C. ORGANIC LIQUID NANOCLUSTER SOURCE MATERIAL

→ OP: PREVENT FROM DRYING

→ PHASE SEPARATION

- WATER: to aqueous liquid pretreatment, water treatment or recycle

↓ ORGANIC LIQUID + NANOCLUSTERS ± HOST-SUBSTRATE

→ PHASE SEPARATION

- ORGANIC LIQUID: to hydrocarbon processing

↓ NANOCLUSTERS ± HOST-SUBSTRATE ± GANGUE

→ SLURRY

⇒ TO NANOCLUSTER COLLOID PROCESSING

4D. GASEOUS NANOCLUSTER SOURCE MATERIAL

→ CONDENSOR

→ SCRUBBER(S)

- GAS: to gas processing

↓ WATER + NANOCLUSTERS ± HOST-SUBSTRATE

⇒ OP: TO NANOCLUSTER COLLOID PROCESSING

→ PHASE SEPARATION

- WATER: to water treatment or recycle

↓ NANOCLUSTERS ± HOST-SUBSTRATE

→ SLURRY

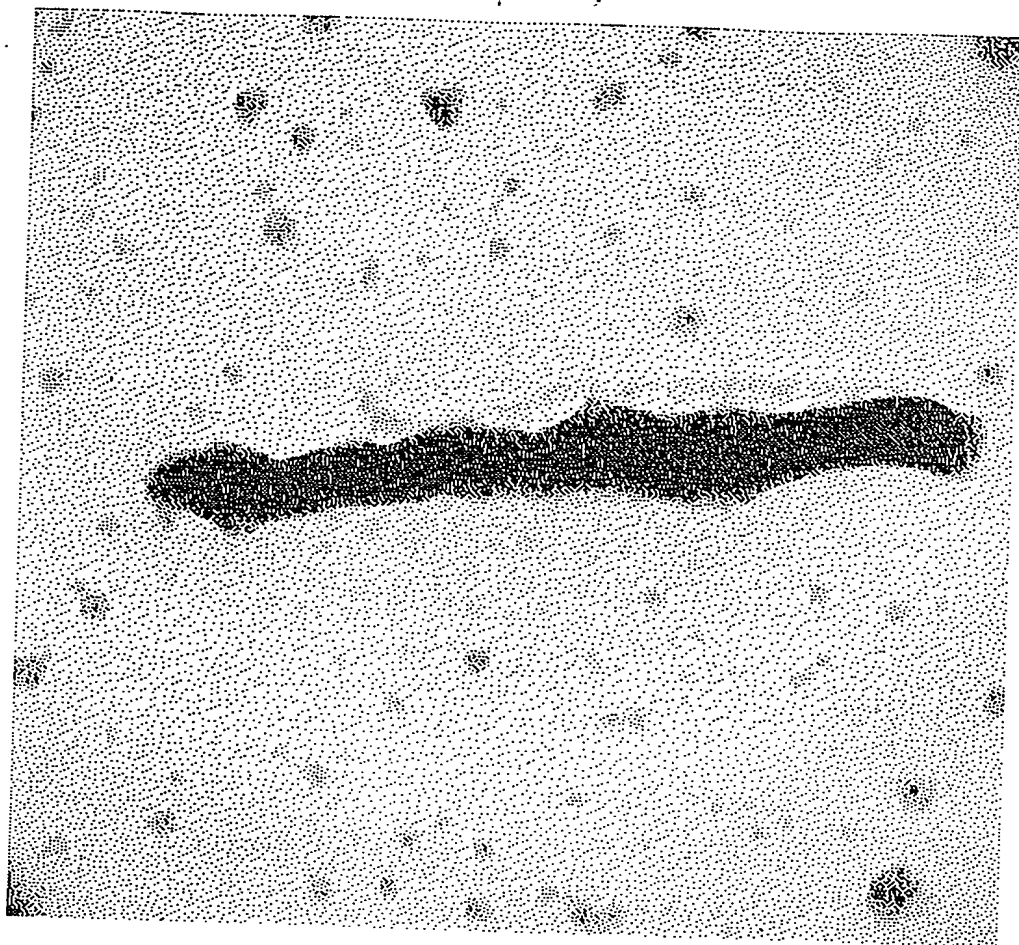
⇒ TO NANOCLUSTER COLLOID PROCESSING

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**Figure 5.** A flow process diagram for nanocluster colloid processing, in accordance with an embodiment of the invention.

- NANOCLUSTERS ± HOST SUBSTRATE ± GANGUE ± WATER (from pretreatment)
  - OP: SLURRY CONDITIONING
  - OP: PHASE SEPARATION
    - WATER: to water treatment or recycle
    - ↓ ORGANIC LIQUID + NANOCLUSTERS ± HOST-SUBSTRATE
  - COLLOID REGENERATION
  - GEL HYDRATION
  - COLLOID PEPTIZATION
  - OP: HEAT & PRESSURE TREATMENT
  - DISPERSION
  - NANOCLUSTER COLLOID DESORPTION
  - PHASE SEPARATION
    - DEPLETED HOST SUBSTRATE + GANGUE: to recycle or tailings
    - ↓ AQUEOUS NANOCLUSTER COLLOID SOLUTION
  - NANOCLUSTER COLLOID RECOVERY
  - PHASE SEPARATION, or
  - ADSORPTION
    - WATER: to water treatment or recycle
    - ↓ NANOCLUSTER CONCENTRATE
  - OP: REFINE
  - ↓ MACROCRYSTALLINE SOLID PRODUCT

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**FIGURE 6**